Dear Editor,

Thank you for sending us the referee reports and handling our manuscript. We are pleased to see the Referees' positive comments. Referee 1 considers that our manuscript 'is well written and clearly argues the theoretical and experimental case,' whereas Referee 2 thinks that the 'experimental data and theory calculations are solid', and that our work 'deserves publication.' We are also grateful to the Referees for their constructive comments and suggestions, which have helped us improve the quality of our work. We answer all of these points below, and list the changes we have made to the paper in response. With these changes, we are confident that our work is suitable for publication in Scipost.

Sincerely,

S. Thirupathaiah, Y. S. Kushnirenk, K. Koepernik, B. R. Piening, B. Buechner, S. Aswartham, J. van den Brink, S. V. Borisenko, and I. C. Fulga

Reply to Referee 1

Authors study electronic properties of $PtBi_2$ using DFT calculations. They find that this material has sixfold band touching (sixfold fermion). The manuscript is well written and clearly argues the theoretical and experimental case. The only room for improvement would be figures:

We thank the Referee for their report and their suggestions for improvement. We answer each one of them below.

1) I would suggest to use different color scheme for calculations and experimental data.

We agree with the Referee that it should be easy to distinguish at a glance which plots are theoretical and which are experimental. For this reason, we have labeled all plots showing calculated data with 'theory,' so that they can more easily be differentiated from the measurements. The reason for labeling only the theory plots is that their data is perfectly symmetric and periodic across multiple BZs, such that the label does not effectively obscure any data. We believe that using different color schemes for the theory and experimental plots may be confusing to the reader, and would make it hard to compare the features they share in common, as well as those which are different.

2) The FS data in Fig. 2 is plotted over many Brillouin zones (BZ) which makes it very unclear. If authors want to show multi zone plot I would suggest using just a single panel, then plotting only single BZ for each photon energy, so reader can see better the differences.

We have followed the Referee's advice, and added a new panel to Fig. 2, which shows a side-by-side comparison of a single BZ from each of the other panels. We have kept the other panels in the figure, however, since the measurement over multiple BZs provides additional information, for instance due to the fact that matrix elements vary across BZs, leading to different intensities.

3) Fig 3 and 4 are key to the claims of the paper. The crosses obscure the data and it is not clear that the bands form the Dirac points, let alone six fold ones.

Perhaps adding a panel or figure that shows more clearly the Dirac points and all bands could resolve the issue. The authors could also try second derrivative technique to better visualize the bands.

To make the data more visible, we have replaced the crosses with arrows, such that they do not overlap with the features they point to.

We have tried different ways to visualize the data, but found out that a direct comparison between the raw experimental data and theory is the most convincing and reliable one. Although the second derivative (example below) makes some features more pronounced, it distorts the overall picture, which, in this case, is essential to understand the experimental electronic structure.

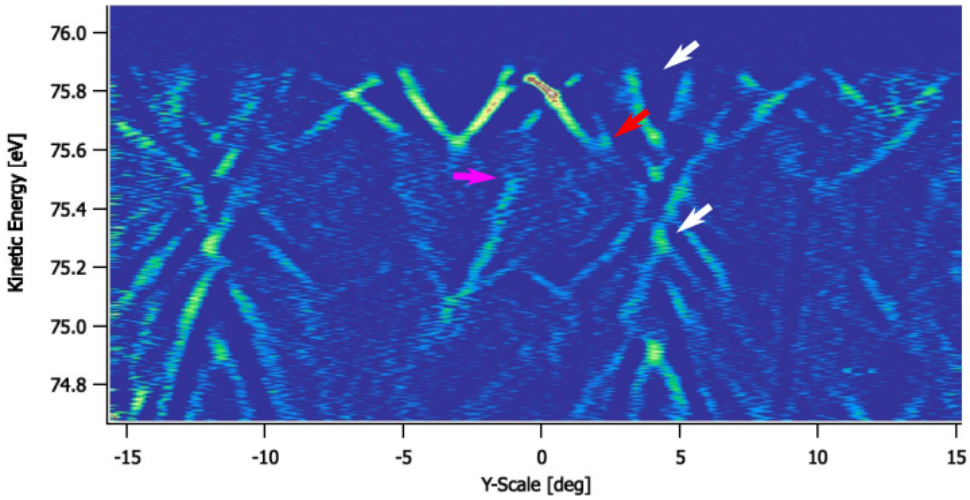

Figure 1: Second derivative of the data shown in Fig. 4b of the paper. The arrows indicate the positions of the Dirac points and of the sixfold band crossings, using the same colors as described in the paper.

Reply to Referee B

The authors report the experimental realization of a high order nodal point semimetal PtBi2. The experimental data and theory calculations are solid, and it deserves publication. I have a couple of objections that should be addressed.

We thank the Referee for their report and for their positive evaluation of our work. We address in detail their comments below.

1. Could the author use arrows also in Fig. (2) to be able to follow the explanation of the text ?

We have added arrows to both Fig. 1 and Fig. 2, which point to the features described in the main text.

2. They claim under a Zeeman field the bands split in 20 Weyl points. They should explain why they are all Weyl nodes.

The band crossing points are Weyl nodes because they carry the topological charge associated to Weyl points. Specifically, the Berry curvature integrated over a closed surface surrounding the band crossing point yields a monopole charge of either $Q = +1$ or $Q = -1$. This monopole charge is indicated in the caption of Fig. 6, as mentioned in the main text. To make our results more easily reproducible, we have also added a python code as a Supplemental Material to the original arXiv submission. This code implements the low-energy Hamiltonian of Eq. (1) and numerically determines the topological charge of each band crossing point, thus proving that they are Weyl cones. However, we realize that in the previous version of our paper we did not mention the existence of this code. We have clarified this in the new version, where after referencing Fig. 6 we point to the code that confirms the topological nature of the band crossings.